Annual Technical Report 2019

FY2019 OITDA

Optoelectronics Industry and Technology Development Association

— CONTENTS —

Message from OITDA

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It is my pleasure to issue "Annual Technical Report 2019" which outlines the result of our surveys and R&D activities in FY2019.

OITDA has been promoting the formulation of a research and development strategy and commercialization strategy through cooperation among industry, academia and government regarding the optoelectronics technologies. At the same time, OITDA has engaged in the priority issues such as survey and research on the optoelectronics technology and industry, promotion of technology development, and promotion of standardization.

You can find the details of our activities in this report. So, I would like to point out noteworthy events in FY 2019. First, we have set up the sub-committee under the "Technology Strategy Formulation Committee" and developed the "Optical Imaging and Sensing Technology Roadmap – Seeing the Unseen –." The results of this activity were presented at the FY2019 Symposium on the Optoelectronics Industry and Technology, which was held at the Rihga Royal Hotel Tokyo on Wednesday, February 19th, 2020. This roadmap includes technologies for non-invasive measurement of human health status.

With regard to standardization, we actively carried out international standardization activities at IEC, ISO, and other forums, primarily for the standardization of in-vehicle high-speed optical Ethernet, connectors for interconnection of optical fibers, and silicon photonics interconnect and optical switches through the governmental project.

In order to support the growth of the optoelectronics industry and technology, OITDA will strengthen and enhance our activities in accordance with needs, under the guidance of the Ministry of Economy, Trade and Industry and other governmental organizations and with the understanding and cooperation of our supporting members and many other people from the business world and the academic community who are our important partners. We look forward to your continued guidance, support, and cooperation.

Optoelectronics Industry Trends

1. Introduction

OITDA has conducted "Survey of Trends of the Optoelectronics Industry" annually since its foundation in 1980. The accumulated survey data of more than 40 years are highly regarded as the basic source for properly recognizing the trend of optoelectronics industry.

This year, we have set seven research sub-committee under the "Optoelectronic Industry Trends Investigation Committee" and have conducted survey for getting the statistical data from FY 2018 to FY 2020, including the shipment value and domestic production value of entire optoelectronic industry.

2. Total Shipments and Domestic Production for the Optoelectronics Industry

2.1 Survey Method

1) We have sent the questionnaire for actual results for FY 2018, estimated values for FY 2019, and qualitative predictions for FY 2020 concerning total shipments and domestic production to the Japanese companies which produce optoelectronics-related products (optoelectronics equipment/systems, optical components).
2) In addition to the questionnaire survey, we also referred to the data of the Japan Photovoltaic Energy Association (JPEA), Japan Lighting Manufacturers Association (JLMA), Japan Electronics and Information Technology Industries Association (JEITA), Camera & Imaging Products Association (CIPA), and Fuji Chimera Research Institute, Inc. regarding the photovoltaic energy field, solid-state lighting field, display field, and I/O field.

In the survey in FY2019, we changed the unit used to show the total shipments and domestic production in the summary sheet, from million yen to 100 million yen.

For the survey, we classified the optoelectronics industry, together with relevant optical equipment/systems and components, into the seven fields shown below.

1. Optical Communication:	Optical transmission equipment/systems, optical fiber fusion splicer, light emitting devices, photo detectors, optical passive components, optical fiber, optical connectors, etc.
2. Optical Storage:	Optical disc equipment (read-only, recordable), optical disc media, laser diodes, etc.
3. Input/Output (I/O):	Optical printers, multifunction printers, digital cameras, digital video cameras, camera mobile phones, image sensors, etc.
4. Display and Solid-state Lighting:	Flat panel display devices and equipment, projectors, solid-state lighting devices and equipment, LED (for lighting and displays), etc.
5. Photovoltaic Energy:	Photovoltaic power generation systems, photovoltaic cells and modules
6. Laser/Optical Processing:	Laser/optical processing equipment, lamp/LD lithography, additive manufacturing (3D printers), laser oscillators
7. Sensing and Measuring:	Optical measuring instruments, optical sensing equipment
8. Others:	Hybrid optical devices, etc.

2.2 Overview of Survey Results of Total Shipments

Table 1 shows the results of FY 2018 (actual), FY 2019 (estimate) and FY 2020 (predictions) for total shipments.

● FY 2018 (actual): 13,285 billion yen, growth rate: −4.8%

In FY 2018, total shipments (actual) for the optoelectronics industry amounted to 13,285 billion yen (growth rate: −4.8%). This breaks down as: 9,263 billion yen for optoelectronics equipment/systems (growth rate: −4.8%, component ratio: 69.7%) and 4,022 billion yen for optical components (growth rate: −5.0%, component ratio: 30.3%).

The shipments by field were:
487 billion yen for the optical communication field (growth rate: −3.3%, component ratio: 3.7%),
735 billion yen for the optical storage field (growth rate: −6.5%, component ratio: 5.5%),
3,363 billion yen for the I/O field (growth rate: −8.3%, component ratio: 25.3%),
5,306 billion yen for the display and solid-state lighting field (growth rate: −5.2%, component ratio: 40.1%),
2,278 billion yen for the photovoltaic energy field (growth rate: −2.4%, component ratio: 17.1%),
763 billion yen for the laser/optical processing field (growth rate: 4.6%, component ratio: 5.7%),
and 244 billion yen for the sensing and measuring field (growth rate: 4.9%, component ratio: 1.8%).

● FY 2019 (estimate): 12,847 billion yen, growth rate: −3.3%

Total shipments for the optoelectronics industry in FY 2019 are estimated to be 12,847 billion yen (growth rate: −3.3%). This breaks down as: 8,811 billion yen for optoelectronics equipment/systems (growth rate: −4.9%, component ratio: 68.6%) and 4,036 billion yen for optical components (growth rate: 0.3%, component ratio: 31.4%).

The shipments by field are estimated to be:
516 billion yen for the optical communication field (growth rate: 5.9%, component ratio: 4.0%),
661 billion yen for the optical storage field (growth rate: −10.0%, component ratio: 5.1%),
3,416 billion yen for the I/O field (growth rate: 1.6%, component ratio: 26.6%),
4,942 billion yen for the display and solid-state lighting field (growth rate: −6.9%, component ratio: 38.6%),
2,261 billion yen for the photovoltaic energy field (growth rate: −0.8%, component ratio: 17.6%),
698 billion yen for the laser/optical processing field (growth rate: −8.5%, component ratio: 5.4%),
and 249 billion yen for the sensing and measuring field (growth rate: 2.1%, component ratio: 1.9%).

● FY 2020 (predictions): flat

Total shipments are projected to be flat for the optoelectronics industry overall, as well as for optoelectronics equipment/systems and optical components in FY 2020. By field, the optical communication field, the I/O field, the display and solid-state lighting field, the photovoltaic energy field, the laser/optical processing field, and the sensing and measuring field will remain steady. The optical storage field will decrease slightly.

2.3 Overview of Survey Results of Domestic Production

Table 2 shows the results of FY 2018 (actual), FY 2019 (estimate) and FY 2020 (predictions) for Domestic Production.

● FY 2018 (actual): 6,714 billion yen, growth rate: −7.4%

In FY 2018, the domestic production of the optoelectronics industry (actual) was 6,714 billion yen (growth rate: −7.4%). This breaks down as: 4,084 billion yen for optoelectronics equipment/systems (growth rate: −1.8%, component ratio: 60.8%) and 2,630 billion yen for optical components (growth rate: −15.0%, component ratio: 39.2%).

The domestic production by field was:
388 billion yen for the optical communication field (growth rate: −3.7%, component ratio: 5.8%),
90 billion yen for the optical storage field (growth rate: −31.6%, component ratio: 1.3%),
941 billion yen for the I/O field (growth rate: −14.0%, component ratio: 14.0%),

2,568 billion yen for the display and solid-state lighting field (growth rate: −9.0%, component ratio: 38.2%),
1,754 billion yen for the photovoltaic energy field (growth rate: −3.8%, component ratio: 26.1%),
696 billion yen for the laser/optical processing field (growth rate: −2.6%, component ratio: 10.4%),
and 200 billion yen for the sensing and measuring field (growth rate: 9.3%, component ratio: 3.0%).

● **FY 2019 (estimate): 6,347 billion yen, growth rate: −5.5%**

The domestic production of the optoelectronics industry in FY 2019 is estimated to be 6,347 billion yen (growth rate: −5.5%). This breaks down as: 3,811 billion yen for optoelectronics equipment/systems (growth rate: −6.7%, component ratio: 60.0%) and 2,536 billion yen for optical components (growth rate: −3.6%, component ratio: 40.0%).

The domestic production by field was:
414 billion yen for the optical communication field (growth rate: 6.7%, component ratio: 6.5%),
75 billion yen for the optical storage field (growth rate: −17.4%, component ratio: 1.2%),
941 billion yen for the I/O field (growth rate: 0.0%, component ratio: 14.8%),
2,439 billion yen for the display and solid-state lighting field (growth rate: −5.0%, component ratio: 38.4%),
1,574 billion yen for the photovoltaic energy field (growth rate: −10.2%, component ratio: 24.8%),
626 billion yen for the laser/optical processing field (growth rate: −10.0%, component ratio: 9.9%),
and 200 billion yen for the sensing and measuring field (growth rate: 0.0%, component ratio: 3.2%).

● **FY 2020 (predictions): Slight decrease**

The domestic production of the optoelectronics industry in FY 2020 is projected to decrease slightly. Optoelectronics equipment/systems will be flat and optical components will decrease slightly.

By field, the optical communication field, the I/O field, the photovoltaic energy field, the laser/optical processing field, and the sensing and measuring field will remain steady, while the optical storage field the display and solid-state lighting field will decrease slightly.

2.4 Trend in Optoelectronics Industry

Fig.1 and Fig.2 show changes in the total shipment value of the optoelectronics industry and trends in each field. Fig.3 and Fig.4 show changes in the domestic production value of the optoelectronics industry and changes by field. Fig.1 and Fig.3 show nominal GDP and electronic industry production in order to compare changes in the scale of the optoelectronics industry with those of the Japanese economy and other industries. Below is a summary of the survey and analysis results of the latest survey.

● **FY2018 (actual)**

Due to the solid capital investment primarily in the semiconductor and automotive industry, the total shipments in the laser/optical processing field as well as the total shipments and domestic production in the sensing and measuring field maintained a positive growth, whereas the total shipments and domestic production in the other five fields decreased or slightly decreased.

In the optical communication field, optical transmission components for trunk/metro lines and subscriber lines started to increase due to an increase in domestic facility capital investments for 5G systems, and optical fibers and optical connectors stayed firm, whereas components such as optical transmission links decreased due to competition with overseas manufacturers; as a result, both the total shipments and domestic production decreased slightly.

In the I/O field, both the total shipments and domestic production decreased since smartphone decreased significantly and the market for digital cameras also continued to shrink.

In the display and solid-state lighting field, both the total shipments and domestic production decreased slightly since display elements decreased significantly although 4K TVs and LED lighting fixtures were firm.

In the optical storage field, the total shipments decreased slightly and domestic production decreased due to continuing demand decline.

In the photovoltaic energy field, both the total shipments and domestic production decreased due to price declines. However, the decrease was slight since the significant downward trend associated with the change in the Feed in Tariff (FIT) system had finally been put to a halt.

In the optoelectronics industry as a whole, the total shipments were 13,285 billion (growth rate: −4.8%) and the domestic production was 6,714 billion yen (−7.4%), resulting in a slight decrease.

● **FY 2019 (estimate)**

In the optical communications field, both the total shipments and domestic production are estimated to increase since optical transmission equipment and systems as a whole will perform well due to an increase in domestic capital investments for 5G systems, and components such as light-emitting elements and optical connectors also will stay firm.

In the I/O field, both the total shipments and domestic production are estimated to be almost flat since a decrease in smartphones and digital cameras will be compensated by an increase in image sensors and in-vehicle cameras.

In the laser/optical processing field, although excimer lasers have performed well, capital investments mainly for semiconductor memories and flat panel displays is forecast to decelerate. The total shipments and domestic production will start to show negative growth.

In the sensing and measuring field, sensors such as laser radars are estimated to stay firm, which will maintain positive growth in the total shipments.

In the display and solid-state lighting field, price declines for 4K and large-screen TVs are likely to be accelerated despite demand increase, and LED lighting fixtures will grow slowly due to widespread use. Thus, both the total shipments and domestic production are estimated to decrease slightly.

In the optical storage field, both the total shipments and domestic production are estimated to decrease since demand decline continues due to the progress of internet distribution.

In the photovoltaic energy field, the total shipments are estimated to be almost flat due to price declines despite an increase in applications. The domestic production is expected to decrease due to higher dependency on overseas production.

In the optoelectronics industry as a whole, the total shipments (12,847 billion yen, growth rate: −3.3%) and domestic production (6,347 billion yen, growth rate: −5.5%) are expected to decrease slightly following the previous fiscal year.

● **FY 2020 (predictions)**

In the optical communications field, the total shipments and domestic production are projected to remain flat since domestic capital investments for 5G systems will continue.

In the I/O field, the total shipments and domestic production are projected to remain flat due to the continuing tendency of a decrease in smartphones and digital cameras and an increase in image sensors.

In the laser/optical processing field and the sensing and measuring field, although a slow recovery for facility capital investments for semiconductors and others can be forecast, the total shipments and domestic production are projected to be flat because favorable factors are insufficient.

In the display and solid-state lighting fields, display elements will continue to decrease amid severe competition although high-value-added

Table 1　Shipment of Optoelectronics Industry (Summary)

Product Items	FY 2017 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2018 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2019 Shipment Estimate (in 100 million yen)		Growth Rate(%)	FY 2020 Shipment Prediction
Optical Communications Field	5,037		▲ 3.7	4,870		▲ 3.3	5,158		**5.9**	flat
Optical Equipment: Optical Transmission Equipment	1,352		▲ 6.6	1,362		**0.7**	1,585		**16.4**	flat
Optical Equipment: Truck Line and Metro Line		542	▲ 24.2		649	**19.7**		736	**13.4**	flat
Optical Equipment: Subscriber Line		417	8.0		378	▲ 9.4		430	**13.8**	flat
Optical Equipment: Router and Switch		326	19.4		261	▲ 19.9		264	**1.1**	slight increase
Optical Equipment: Optical Fiber Amplifier		67	▲ 8.2		74	**10.4**		155	**109.5**	increase
Optical Component: Optical Transmission Components	3,471		▲ 2.7	3,297		▲ 5.0	3,376		**2.4**	flat
Optical Component: Optical Transmission Link		806	4.7		553	▲ 31.4		509	▲ 8.0	flat
Optical Component: Light Emitting Device		550	▲ 17.5		543	▲ 1.3		642	**18.2**	slight increase
Optical Component: Photo Detectors		169	▲ 28.7		179	**5.9**		150	▲ 16.2	flat
Optical Component: Optical Passive Component		243	▲ 7.6		236	▲ 2.9		227	▲ 3.8	slight increase
Optical Component: Optical Circuit Component		297	3.1		280	▲ 5.7		277	▲ 1.1	flat
Optical Component: Optical Fiber		981	0.1		1,080	**10.1**		1,045	▲ 3.2	slight decrease
Optical Component: Optical Connector		269	17.0		271	**0.7**		312	**15.1**	flat
Optical Component: Others (Semiconductor Amplifying Device, etc.)		156	16.4		155	▲ 0.6		214	**38.1**	flat
Optical Fiber Fusion Splicer	214		0.9	211		▲ 1.4	197		▲ 6.6	flat
Optical Storage Field	7,861		▲ 5.3	7,349		▲ 6.5	6,611		▲ 10.0	slight decrease
Optical Equipment: Optical Disk	7,729		▲ 4.8	7,248		▲ 6.2	6,530		▲ 9.9	slight decrease
Optical Equipment: Equipment		7,329	▲ 5.5		6,889	▲ 6.0		6,187	▲ 10.2	slight decrease
Optical Equipment: Read-only (CD, DVD, BD)		4,984	▲ 2.7		4,689	▲ 5.9		4,063	▲ 13.4	slight decrease
Optical Equipment: Recordable		2,345	▲ 11.1		2,200	▲ 6.2		2,124	▲ 3.5	slight decrease
Optical Equipment: Media		400	9.9		359	▲ 10.3		343	▲ 4.5	flat
Laser Diode		132	▲ 26.7		101	▲ 23.5		81	▲ 19.8	decrease
Input/Output Field	36,681		3.8	33,625		▲ 8.3	34,156		**1.6**	flat
Optical Equipment: Optical I/O Equipment	28,711		0.3	24,988		▲ 13.0	23,307		▲ 6.7	flat
Optical Equipment: Optical Printer・Multifunction Printer		7,207	0.0		7,056	▲ 2.1		6,884	▲ 2.4	flat
Optical Equipment: Imaging equipment		10,991	–		9,859	▲ 10.3		8,805	▲ 10.7	flat
Optical Equipment: Digital Camera, Digital Video Camera		9,439	3.2		8,211	▲ 13.0		7,006	▲ 14.7	slight decrease
Optical Equipment: Security camera, Car-mounted camera *		1,552	–		1,648	**6.2**		1,799	**9.2**	slight increase
Optical Equipment: Camera Mobile Phone		9,690	▲ 0.8		7,443	▲ 23.2		7,088	▲ 4.8	flat
Optical Equipment: Others (Barcode Reader, Image Scanner, etc.)		823	▲ 12.6		630	▲ 23.5		530	▲ 15.9	flat
Image Sensor	7,970		17.4	8,637		**8.4**	10,849		**25.6**	slight increase
Display and Solid-state Lighting Field	55,967		6.0	53,060		▲ 5.2	49,417		▲ 6.9	flat
Optical Equipment: Display Equipment	26,817		15.2	26,146		▲ 2.5	25,125		▲ 3.9	flat
Optical Equipment: Flat Panel Display		23,925	15.9		23,594	▲ 1.4		22,768	▲ 3.5	flat
Optical Equipment: Projector		2,741	9.9		2,392	▲ 12.7		2,190	▲ 8.4	flat
Optical Equipment: Large-scale LED Display		151	11.9		160	**6.0**		167	**4.4**	flat
Display Device	18,704		▲ 2.2	16,326		▲ 12.7	14,027		▲ 14.1	slight decrease
Solid-state Lighting	6,937		3.1	6,940		**0.0**	6,807		▲ 1.9	slight decrease
Solid-state Lighting: LED Device		6,286	5.1		6,422	**2.2**		6,358	▲ 1.0	slight decrease
Solid-state Lighting: LED Lamp		651	▲ 12.7		518	▲ 20.4		449	▲ 13.3	slight decrease
LED	3,509		▲ 4.5	3,648		**4.0**	3,458		▲ 5.2	flat
Photovoltaic Energy Field	23,338		▲ 17.6	22,783		▲ 2.4	22,605		▲ 0.8	flat
Photovoltaic Power System		16,600	▲ 16.3		16,374	▲ 1.4		15,697	▲ 4.1	flat
Photovoltaic Cell/Module		6,738	▲ 20.5		6,409	▲ 4.9		6,908	**7.8**	flat
Laser/Optical Processing Field	7,297		13.1	7,630		**4.6**	6,978		▲ 8.5	flat
Optical Equipment: Laser and Optical Processing Equipment	6,593		13.8		6,925	**5.0**		6,375	▲ 7.9	flat
Optical Equipment: CO_2 Laser		543	6.5		466	▲ 14.2		249	▲ 46.6	flat
Optical Equipment: Solid State Laser		440	9.5		479	**8.9**		467	▲ 2.5	flat
Optical Equipment: Fiber Laser		631	10.5		734	**16.3**		753	**2.6**	flat
Optical Equipment: Semiconductor Laser Direct Processing Equipment		35	12.9		39	**11.4**		42	**7.7**	slight increase
Optical Equipment: Excimer Laser		1,407	▲ 6.9		1,507	**7.1**		1,990	**32.1**	flat
Optical Equipment: Lamp/LD Exposure Machine		3,506	27.7		3,672	**4.7**		2,852	▲ 22.3	flat
Optical Equipment: Additive Manufacturing (3D Printer)		31	34.8		28	▲ 9.7		22	▲ 21.4	flat
Oscillator	704		6.7		705	**0.1**		603	▲ 14.5	flat
Optical Sensing and Measurement Field	2,325		4.6	2,438		**4.9**	2,489		**2.1**	flat
Optical Measuring Instrument		123	▲ 3.9		119	▲ 3.3		137	**15.1**	flat
Optical Sensing Equipment		2,202	5.2		2,319	**5.3**		2,352	**1.4**	flat
Others Field		1,103	0.2	1,096		▲ 0.6	1,055		▲ 3.7	flat

Product Items	FY 2017 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2018 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2019 Shipment Estimate (in 100 million yen)		Growth Rate(%)	FY 2020 Shipment Prediction
Sub Total for Optoelectronics Equipment	97,278		2.2	92,632		▲ 4.8	88,112		▲ 4.9	flat
Sub Total for Optoelectronics Components	42,331		▲ 2.9	40,219		▲ 5.0	40,357		**0.3**	flat
Total for Optoelectronics Products	139,609		0.6	132,851		▲ 4.8	128,469		▲ 3.3	flat

Table 2 Domestic Production of Optoelectronics Industry (Summary)

Product Items	FY 2017 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2018 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2019 Shipment Estimate (in 100 million yen)		Growth Rate(%)	FY 2020 Shipment Prediction
Optical Communications Field	4,033		▲ 8.5	3,883		▲ 3.7	4,142		**6.7**	flat
Optical Equipment / Optical Transmission Equipment	1,241		▲ 6.3	1,181		▲ 4.8	1,389		**17.6**	flat
Optical Equipment / Truck Line and Metro Line		536	▲ 24.2		628	**17.2**		715	**13.9**	flat
Optical Equipment / Subscriber Line		461	23.9		368	▲ 20.2		420	**14.1**	flat
Optical Equipment / Router and Switch		191	3.2		125	▲ 34.6		122	▲ 2.4	flat
Optical Equipment / Optical Fiber Amplifier		53	▲ 13.1		60	**13.2**		132	**120.0**	increase
Optical Component / Optical Transmission Components	2,578		▲ 10.2	2,499		▲ 3.1	2,566		**2.7**	flat
Optical Component / Optical Transmission Link		384	▲ 23.8		308	▲ 19.8		318	**3.2**	slight decrease
Optical Component / Light Emitting Device		319	▲ 26.5		277	▲ 13.2		325	**17.3**	slight increase
Optical Component / Photo Detectors		117	▲ 36.1		77	▲ 34.2		58	▲ 24.7	slight decrease
Optical Component / Optical Passive Component		228	▲ 4.2		207	▲ 9.2		203	▲ 1.9	slight increase
Optical Component / Optical Circuit Component		238	▲ 9.8		227	▲ 4.6		225	▲ 0.9	flat
Optical Component / Optical Fiber		927	▲ 1.8		1,008	**8.7**		955	▲ 5.3	slight decrease
Optical Component / Optical Connector		223	18.6		250	**12.1**		277	**10.8**	flat
Optical Component / Others (Semiconductor Amplifying Device, etc.)		142	21.4		145	**2.1**		205	**41.4**	flat
Optical Fiber Fusion Splicer	214		0.9	203		▲ 5.1	187		▲ 7.9	flat
Optical Storage Field	1,322		▲ 39.6	904		▲ 31.6	747		▲ 17.4	slight decrease
Optical Equipment / Optical Disk	1,283		▲ 40.2	877		▲ 31.6	723		▲ 17.6	slight decrease
Optical Equipment / Equipment		1,169	▲ 42.5		771	▲ 34.0		622	▲ 19.3	slight decrease
Optical Equipment / Media		114	0.9		106	▲ 7.0		101	▲ 4.7	flat
Laser Diode		39	▲ 4.9		27	▲ 30.8		24	▲ 11.1	flat
Input/Output Field	10,941		▲ 5.2	9,407		▲ 14.0	9,411		**0.0**	flat
Optical Equipment / Optical I/O Equipment	4,859		▲ 15.0	4,463		▲ 8.1	4,167		▲ 6.6	flat
Optical Equipment / Optical Printer・Multifunction Printer		585	▲ 33.5		607	**3.8**		720	**18.6**	flat
Optical Equipment / Imaging equipment		2,935	–		2,608	▲ 11.1		2,274	▲ 12.8	slight decrease
Optical Equipment / Digital Camera, Digital Video Camera		2,619	▲ 0.8		2,279	▲ 13.0		1,903	▲ 16.5	slight decrease
Optical Equipment / Security camera, Car-mounted camera *		316	–		329	**4.1**		371	**12.8**	slight increase
Optical Equipment / Camera Mobile Phone		1,095	▲ 24.2		1,001	▲ 8.6		945	▲ 5.6	slight decrease
Optical Equipment / Others (Barcode Reader, Image Scanner, etc.)		244	▲ 35.8		247	**1.2**		228	▲ 7.7	slight decrease
Image Sensor	6,082		3.6	4,944		▲ 18.7	5,244		**6.1**	slight increase
Display and Solid-state Lighting Field	28,218		▲ 1.0	25,678		▲ 9.0	24,386		▲ 5.0	slight decrease
Optical Equipment / Display Equipment	5,031		▲ 1.2	4,886		▲ 2.9	4,586		▲ 6.1	flat
Optical Equipment / Flat Panel Display		4,658	▲ 2.3		4,534	▲ 2.7		4,250	▲ 6.3	flat
Optical Equipment / Projector		222	2.3		192	▲ 13.5		169	▲ 12.0	flat
Optical Equipment / Large-scale LED Display		151	41.1		160	**6.0**		167	**4.4**	flat
Display Device	16,550		▲ 2.9	13,883		▲ 16.1	13,063		▲ 5.9	slight decrease
Solid-state Lighting	4,587		6.8	4,777		**4.1**	4,717		▲ 1.3	slight decrease
LED Device		4,468	6.7		4,674	**4.6**		4,627	▲ 1.0	slight decrease
LED Lamp		119	9.2		103	▲ 13.4		90	▲ 12.6	slight decrease
LED	2,050		▲ 0.3	2,132		**4.0**	2,020		▲ 5.3	flat
Photovoltaic Energy Field	18,226		▲ 17.1	17,535		▲ 3.8	15,742		▲ 10.2	flat
Photovoltaic Power System		16,073	▲ 15.8		16,104	**0.2**		14,597	▲ 9.4	flat
Photovoltaic Cell/Module		2,153	▲ 25.8		1,431	▲ 33.5		1,145	▲ 20.0	decrease
Laser/Optical Processing Field	7,144		13.9	6,959		▲ 2.6	6,262		▲ 10.0	flat
Optical Equipment / Laser and Optical Processing Equipment	6,447		14.6	6,346		▲ 1.6	5,744		▲ 9.5	flat
Optical Equipment / CO_2 Laser		526	11.7		436	▲ 17.1		231	▲ 47.0	flat
Optical Equipment / Solid State Laser		386	12.5		422	**9.3**		415	▲ 1.7	flat
Optical Equipment / Fiber Laser		557	5.3		622	**11.7**		610	▲ 1.9	flat
Optical Equipment / Semiconductor Laser Direct Processing Equipment		34	▲ 2.9		36	**5.9**		34	▲ 5.6	slight increase
Optical Equipment / Excimer Laser		1,407	▲ 4.8		1,507	**7.1**		1,990	**32.1**	flat
Optical Equipment / Lamp/LD Exposure Machine		3,506	27.7		3,295	▲ 6.0		2,442	▲ 25.9	flat
Optical Equipment / Additive Manufacturing (3D Printer)		31	34.8		28	▲ 9.7		22	▲ 21.4	flat
Oscillator	697		7.9	613		▲ 12.1	518		▲ 15.5	flat
Optical Sensing and Measurement Field	1,833		1.6	2,003		**9.3**	2,003		**0.0**	flat
Optical Measuring Instrument		109	▲ 2.7		109	**0.0**		117	**7.3**	flat
Optical Sensing Equipment		1,724	2.0		1,894	**9.9**		1,886	▲ 0.4	slight increase
Others Field		779	2.0		773	▲ 0.8		779	**0.8**	flat

Product Items	FY 2017 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2018 Shipment Actual (in 100 million yen)		Growth Rate(%)	FY 2019 Shipment Estimate (in 100 million yen)		Growth Rate(%)	FY 2020 Shipment Prediction
Sub Total for Optoelectronics Equipment	41,568		▲ 7.4	40,840		▲ 1.8	38,113		▲ 6.7	flat
Sub Total for Optoelectronics Components	30,928		▲ 4.0	26,302		▲ 15.0	25,359		▲ 3.6	slight decrease
Total for Optoelectronics Products	72,496		▲ 5.9	67,142		▲ 7.4	63,472		▲ 5.5	slight decrease

TVs will increase due to demands for replacement and other factors. Thus, the total shipments are projected to remain flat and the domestic production is expected to decrease slightly.

In the optical storage field, both the total shipments and domestic production are projected to decrease slightly due to continuing demand decrease although products such as 4K BDs are likely to increase.

In the photovoltaic energy field, both the total shipments and domestic production will remain flat due to price declines although demand increase is expected.

In the optoelectronics industry as a whole, the total shipments are projected to be flat and the domestic production is projected to decrease slightly. However, there might be a significant gap because the world's economic outlook is uncertain.

3. Global Trends of Optoelectronics Industry

The global trends of the optoelectronics industry are reported below based on the materials presented at the annual conference of the IOA (*1).

(*1) IOA stands for International Optoelectronics Association, a coalition of international optoelectronics-related associations. The current members are organizations from nine countries and regions (Canada, EU, Korea, Germany, Japan, USA, Taiwan, Scotland, and Switzerland), as listed in the right. In the 25th conference in 2020, observers from France and Finland participated.

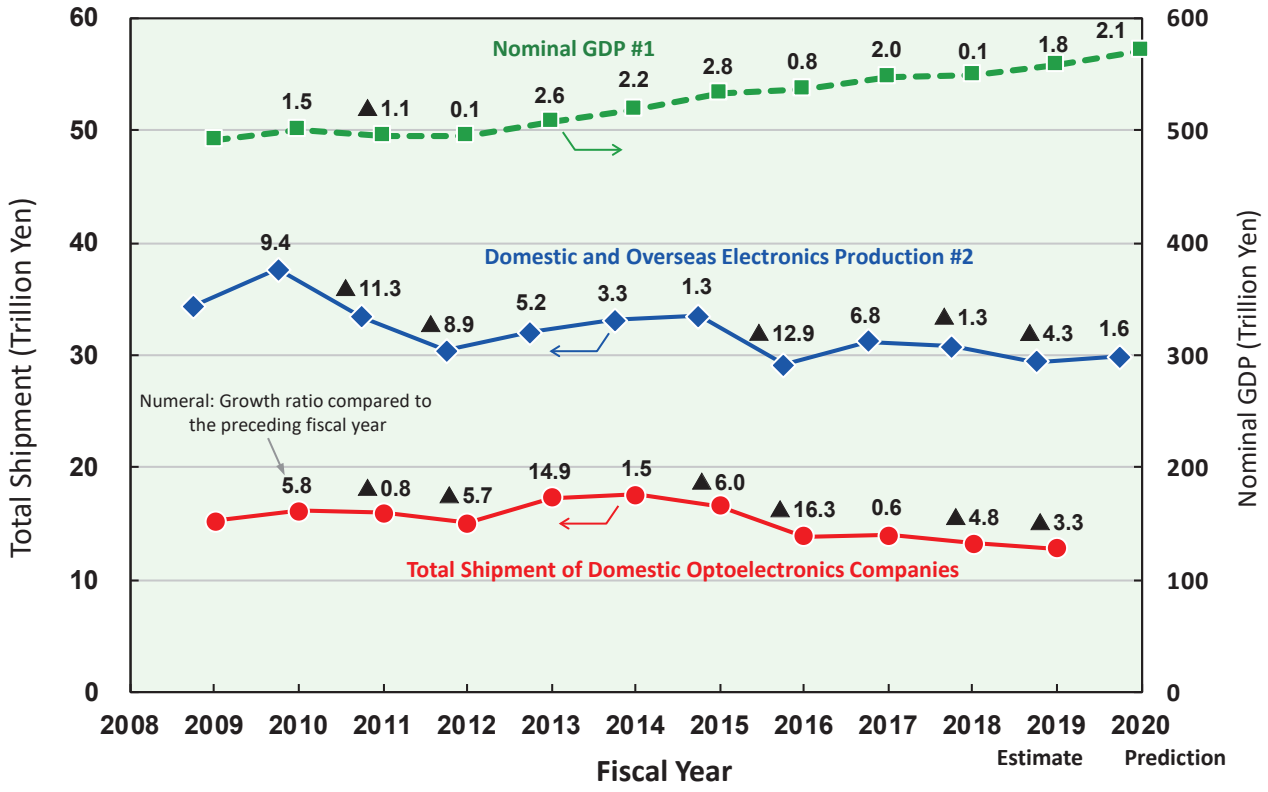
The OIDA (Optoelectronic Industry Development Association, USA) counts the production value of the global optoelectronics industry according to eight fields: communications, consumer imaging, security, lighting, display, solar, machine tools, and life science. The results show that the production value of the global optoelectronics industry in 2019 increased in the four fields below:

(1) communications, (2) consumer imaging, (3) security, and (4) life science

The production in the display field shows a declining tendency although it makes up a significant proportion (component ratio: about 30%). On the contrary, the productions in the information communications filed and the security-related field increased by 11.1% and 12.1% over the previous year, respectively, representing high growth.

In addition, the SPIE (Society of Photo-optical Instrumentation Engineers) counts the sales of the global optoelectronics industry every four years according to ten fields: optical communication, consumer and entertainment, sensing, lighting, displays, solar-PV, advanced manufacturing, biomedical, semiconductors, and defense. In the predictions in 2020, the following three fields are expected to grow in the global optoelectronics market:

(1) consumer and entertainment, (2) solar-PV, and (3) defense



#1 Cabinet Office: National Accounts for 2018/Fiscal 2020 Economic Outlook (Jan. 20, 2020 [Cabinet Decision])

#2 JEITA: Production Forecasts for the Global Electronics and Information Technology Industries, Dec., 2019

Fig.1 Total Optoelectronics Shipment, Nominal GDP, and Domestic & Overseas Electronics Production

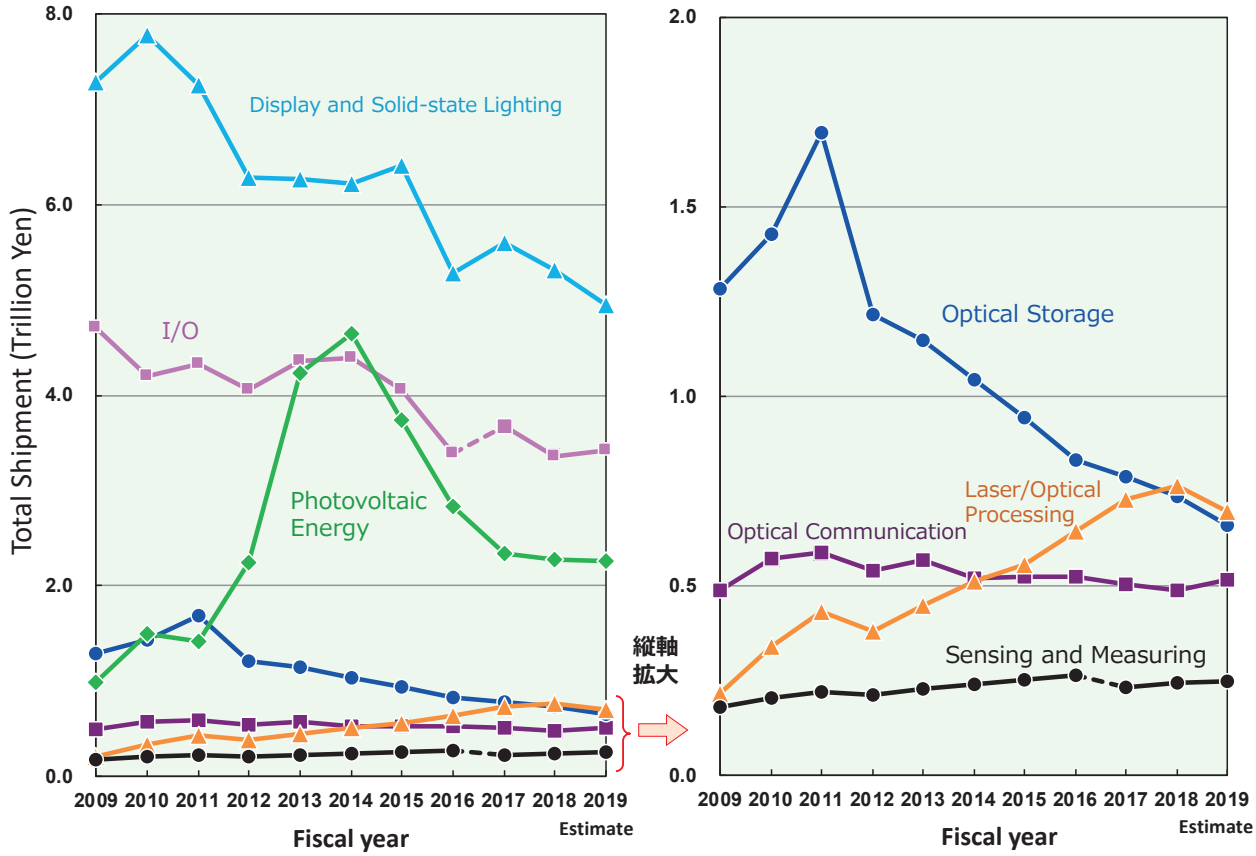
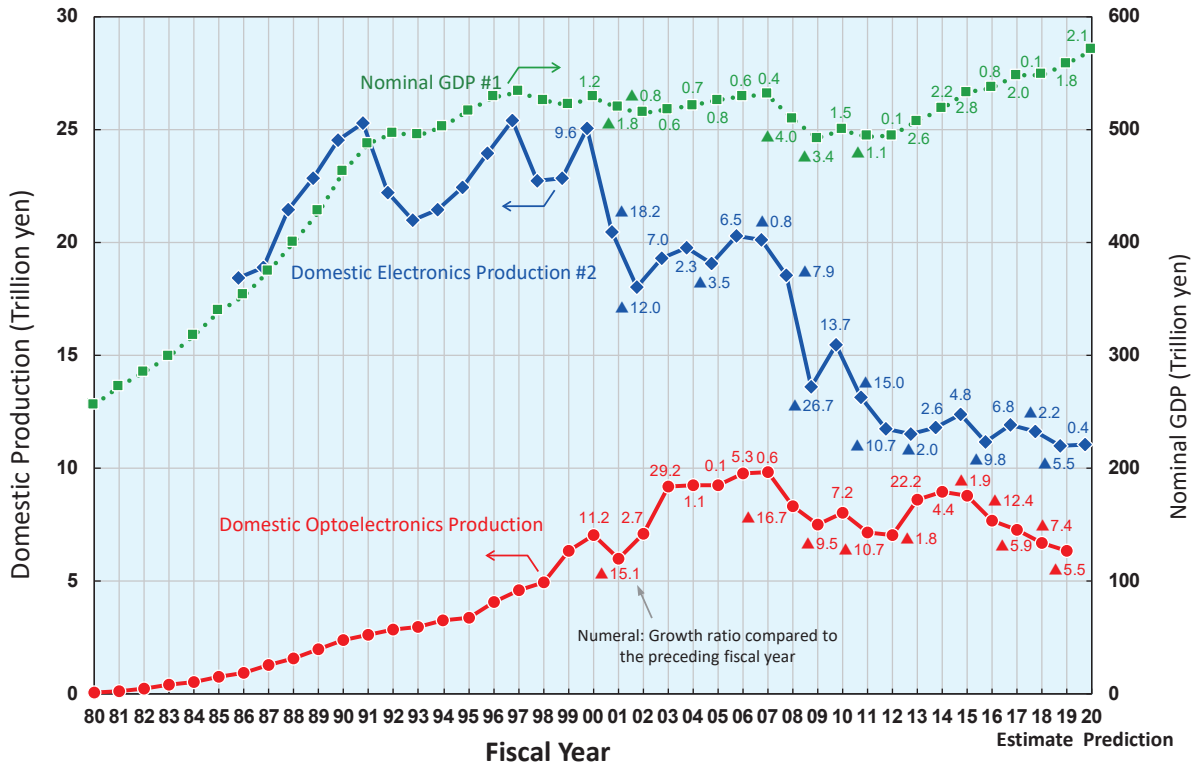


Fig.2 Shipment by Product Field



#1 Cabinet Office: National Accounts for 2018/Fiscal 2019 Economic Outlook (Jan. 20, 2020 [Cabinet Decision])
#2 JEITA: Production Forecasts for the Global Electronics and Information Technology Industries, Dec., 2019

Fig.3 Domestic Optoelectronics Production, Nominal GDP, and Domestic Electronics Production

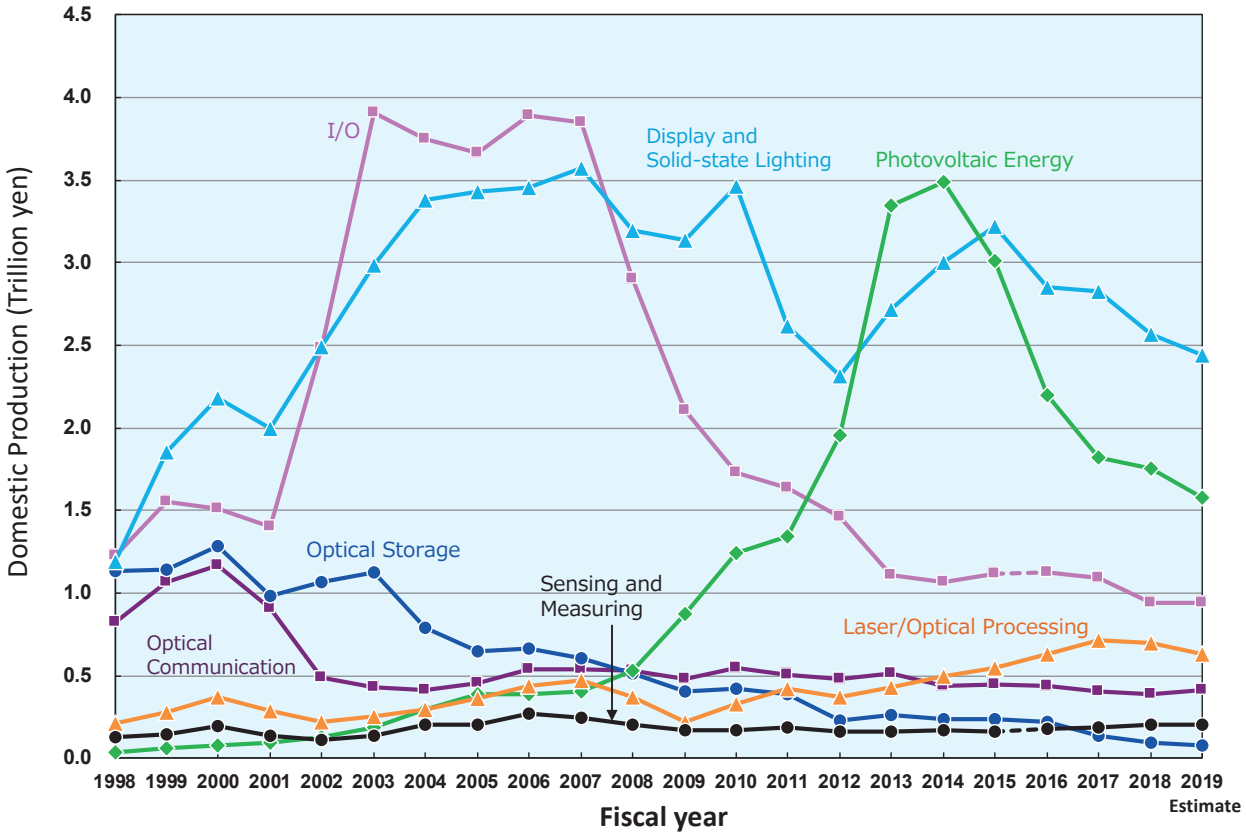


Fig.4 Domestic Optoelectronics Production by Product Field

Technological Strategy Development

1. Introduction

OITDA has been developing "Optical Technology Roadmap" since 1996 with the aim of identifying the future technologies of the optical industry for directing the R&D. This activity has contributed widely to the development of optical industry as one of the key factors of many national R&D projects in the fields of information and telecommunication, recording of information, display device, optical energy and optical processing. In FY2019, the fourth year of the technological strategy development project that focuses on specific application areas, we have developed the roadmap under the theme of "Optical Imaging and Sensing Technology Roadmap – Seeing the Unseen –."

2. Optical technology roadmap

In the face of the super-aging society, problems such as the following have arisen: escalation of medical care costs and labor shortages, which have led people to turn to health improvement and productivity increase. The optical imaging and sensing technology, which offers the advantage of enabling non-destructive and less-invasive measurement, has enhanced the performance and reliability of various optical devices. Given this situation, we selected the following five areas in which the optical imaging and sensing technology is hoped to be utilized in the 2030s: (1) life science, (2) medical care, (3) health management (4) agriculture and livestock industry, and (5) infrastructure. We then identified needs in each area and discussed relevant methods and performance we should aim to achieve for the future society, while comparing the needs with the current technological levels. Finally, we put together element technologies required to realize the goal.

2.1 Life science area

In this area, we picked up two segments, "1A: cell and tissue imaging" and "1B: imaging for cellular and regenerative medicine and drug discovery research." In 1A, in order to improve the performances such as ultra-wide field of vision and deep observation, it is important to promote the sophistication and multi-functionality of optical systems (e.g., ultra-wide-field devices, spatial light modulators, and wavefront correction systems), high-repetition-rate pulsed lasers, and molecular probes. In 1B, unlabeled imaging is required because the technology is hoped to be applied to medical care for clinical use. To this end, it is vital to develop an ultra-wide-field optical system (25 x 25 mm class) as well as an optical system specifically intended for applications such as 96-well plate imaging. Furthermore, a cell and tissue culture system that utilizes technologies including robotics is also important, together with the combination with machine learning.

2.2 Medical care area

In this area, we picked up four segments, "2A: intraoperative imaging and sensing," "2B: endoscopic imaging for cancer invasion depth," "2C: in-vitro optical imaging," and "2D: fertilized egg imaging." In 2A, in order to observe tissues of blood vessels, nerves, and lymphatic vessels at a depth of about 1 cm with a resolution of about 1 mm, it is necessary to develop optical technologies enabling deep focusing as well as a new molecular probe, and to fully utilize digital technologies such as deep learning.

In 2B, it is required to visualize cancer tissues and tumor vessels at depths of several millimeters to about 1 centimeter with resolutions of several micrometers to dozens of micrometers to determine the depth of cancer invasion. For this purpose, technologies for focusing light deep into tissues (including deep focusing technologies that use ultrasound and light in combination) are necessary, as are optical technologies that can achieve both detection sensitivity improvement and noise reduction. In addition, a fluorescent probe that has tumor specificity and assures biological safety must be developed. Furthermore, it is vital to introduce technologies for supporting diagnosis based on machine learning that uses a large volume of endoscopic images of mucosal surfaces as training data.

2C deals with observation for external non-invasive diagnosis of organ tumors about 5 cm below body surfaces, which means that the imaging devices are expected to be used at facilities without advanced medical infrastructure and for remote medical care. To meet this demand, a relatively low-cost and small-sized device also must be developed. Important issues with 2A to 2C are summarized as follows: development of a new molecule probe that will contribute to improving detection sensitivity, utilization of digital technologies such as machine learning and XR, and miniaturization of light sources and detectors. In 2D, technological development is essential to three-dimensionally visualize the refractive index and spectroscopic information of a fertilized egg with a high spatial resolution, while maintaining the less-invasive properties.

2.3 Health management area

Two segments, "3A: disease prediction" and "3B: mental health monitoring," were selected in the health management area.

In 3A, a small and wearable infrared spectroscopic device is necessary, as is a signal analysis method for accurately deriving vital data such as blood pressure, expiration, and blood component based on a certain physical amount (observation signals) obtained from a short-time and simple measurement. In addition, since technologies for high sensitivity detection are essential to commercialize the expiration diagnosis, the light sources, detectors, and optical systems are required to improve their performance.

In 3B, the development of a highly reproducible wearable device and the development of the relevant data processing method are important in order to achieve mental status estimation from vital data.

2.4 Agriculture and livestock industry area

In the agriculture and livestock industry area, we dealt with two segments, "4A: disease/growth state monitoring" and "4B: quality management."

In 4A, in order to realize large-scale and efficient agriculture, it is important to develop technologies for monitoring a growth state by infrared spectroscopy and other methods, as well as for sensing viruses and pathogens in real time. 4B focuses on quality management of the sugar content and umami component of agricultural and livestock products. A multivariate analysis method (a regression model) that combines optical observation data with the intended indicators such as growth state and umami component is necessary, as are the relevant image processing technologies. In addition, the observation equipment is required to have an observation wavelength, bandwidth, and accuracy that are suitable for the intended purposes.

2.5 Infrastructure area

This area was serected into two segments, "5A: image and spectroscopic sensing" and "5B: optical fiber sensing."

In 5A, in order to achieve the risk prediction of structures through displacement, stress, and deterioration evaluation, it is necessary to improve the performance of image analysis for measuring deformation of structures, measuring the stress distribution not involving displacement, and evaluating deterioration of materials. Furthermore, the performance of hybrid measurement of surfaces and inner bodies must be enhanced. To achieve these improvements, it is important to fuse the measurement with other techniques such as stress distribution analysis by polarized imaging, deterioration diagnosis of structure materials by infrared spectroscopy, and ultrasound measurement.

In 5B, it is particularly important to increase the measurement accuracy

of distortion and temperature with distributed optical fiber sensors, in order to make it possible to monitor social infrastructure and house security.

3. Summary

Through the development of this roadmap, we have reached the following three conclusions regarding the optical imaging and sensing technology: (1) There are many needs for applications that take advantage of the non-destructive and less-invasive properties; (2) Although there are many emerging relevant technologies, their practical application is still highly challenging, and thus it is important to steadily develop useful technologies while continuing to create such emerging technologies; (3) It is necessary to combine other imaging and sensing technologies such as those using ultrasound, develop a molecular probe to fully utilize the optical technology, and further strengthen the collaboration with digital technologies including AI.

Finally, the applications of optical imaging and sensing span a wide range of areas, but there are very many common items in regard to its element technologies. We hope that this roadmap will help our associates establish an optical imaging and sensing methodology that will support the future society, while increasing the levels of these element technologies with a view to each application.

Standardization

1. Introduction

Standardization has been one of OITDA's major activities since its establishment and has been promoted broadly across the optoelectronics industry. OITDA's standardization efforts are mainly focused on the optical communication (IEC/TC 86), but they also include several optical applications (ISO/IEC JTC 1/SC 32) and lasers (IEC/TC 76 and ISO/TC 172/SC 9).

Besides, working for domestic standardization (JIS, OITDA standards and Technical papers), OITDA is also working on international standardization such as IEC and ISO through field-specific sub-meetings in order to respond rapid change of industrial structure and technologies.

Outlined below are the results and trends of standardization activities in FY 2019, as well as two international standardization projects commissioned by the Ministry of Economy, Trade and Industry.

2. Fiber Optics Standardization Meeting

Established to constantly take the lead in the standardization activities for fiber optics, the Fiber Optics Standardization Meeting plays a vital role in planning and promoting standardization by adjusting the integrity and overall orientation of the activities while improving the work efficiency, under the direction of the Optoelectronics Industry Technology Standardization Meeting.

In the field of internet communications amid further rapid expansion, 5G is gaining attention as the cutting-edge wireless access technology. Meanwhile, optical access lines are still used in infrastructure that connects transmission base stations and local areas, which makes the standardization of fiber optics increasingly important. Besides, the applicability is expected to broaden, encompassing a diverse range of fields. With such a current trend as a backdrop, it is important to review the purpose and scope of the standardization of fiber optics, identify items to be standardized, and create a vision of ideal standardization.

In FY2019, with its awareness of these issues, the Fiber Optics Standardization Meeting promoted extensive studies and research into fiber optics, and focused its efforts on addressing problems and developing strategic plans in connection with JIS and international standardization. Regarding the organization's standards (OITDA standards) and technical papers (OITDA/TPs) studied and introduced by the meeting to complement JIS and international standards, the Fiber Optics Standardization Meeting aimed to further enhance these documents to expedite the standardization.

In this fiscal year, the meeting organized three research submeetings to conduct its activities: the Administrative Advisory Submeeting, Intra-Building Optical Wiring Submeeting, and Optical Fiber Sensors Submeeting.

In addition, eight meetings were set up at the same level as the Fiber Optics Standardization Meeting: the Optical Fiber Standardization Meeting, Optical Connector Standardization Meeting, Optical Passive Components Standardization Meeting, Optical Active Device Standardization Meeting, Optical Amplifier Standardization Meeting, Dynamic Module Meeting, Optical Subsystem Standardization Meeting, and Optical Measuring Instrument Standardization Meeting. These meetings worked on JIS development in collaboration with IEC/TC 86, which is engaged in preparing the international standards that correspond to the standardization of fiber optics.

3. TC 76/Laser Safety Standardization Meeting

The TC 76/Laser Safety Standardization Meeting functions as a domestic deliberation committee that works with IEC/TC 76, the international electrotechnical committee for standardization regarding optical radiation safety and laser equipment, as well as a draft creation committee that develops relevant JIS standards.

In FY2019, the IEC/TC 76 international conference was held in North Carolina (USA) in October 2019. Described below is the progress of deliberations by each WG.

3.1 Optical radiation safety (WG 1)

In the virtual protective housing project, the virtual protective housing was renamed and redefined as the AEC (Automatic Emission Control: function to reduce the laser classes allocated to target areas). A conceptual difference between a physical protective housing and a virtual protective housing was reviewed and discussed based on the definitions of the "protective housing" and the "human access" described in IEC 60825-1 (Safety of laser products – Equipment classification and requirements).

In the moving platform (that changes the position of measuring opening around the moving body including laser equipment depending on the moving speed) project, the concept defining the human-inaccessible region was discussed to correct the current definition, "cuboid," used in the NP of IEC 60825-19 (Moving Platform Laser Products). As a result, it was decided to use the "volume" occupied by the movement in a specific time (the maximum distance is specified) in a CD.

In the project for intentional beam irradiation for the eye and face, an NP draft is under discussion and an online meeting is held on a monthly basis.

Regarding outside laser products for distance measurement, a project has been launched that aims to establish the reference value according to the ambient brightness.

3.2 Laser radiation measurement (WG 3)

A CD draft is being deliberated at the WG for the revision of IEC/TR 60825-13 Ed.3 (Measurements for classification of laser products).

3.3 Safety of medical laser equipment (WG 4)

Regarding IEC TR 60825-8 (Guidelines for the safe use of laser beams on humans), integration with IEC TR 62471-3 (Guidelines for the safe use of IPL sources on humans) is under consideration.

For IEC 60601-2-57 (Particular requirements for the basic safety and essential performance of non-laser light source equipment intended for therapeutic, diagnostic, monitoring and cosmetic/aesthetic use), the CD draft for Ed.2 revision is under consideration.

3.4 Safety of fiber and free space optical communications systems (WG5)

Regarding IEC 60825-2 (Safety of optical fiber communication systems) Ed.4 proposed by Japan, there were strong objections at the comment deliberation from CDV circulation. To reach a conclusion in a short period, an ad hoc group was set up and then it was decided to submit an FDIS draft by the end of June.

IEC 60825-12 (Safety of optical wireless communication systems for information transmission) Ed.2 proposed by Japan was circulated as an amendment, but a 2CD draft was compiled as Ed.3 revision, instead of Ed.2 amendment, by the end of the fiscal year.

3.5 High power lasers (WG 7)

The FDIS draft of IEC 60825-4 (Laser guards) Ed.3 was deliberated.

For IEC 60825-18 (Beam delivery system), each country's comments from CD circulation were deliberated.

3.6 Development and maintenance of basic standards (WG 8)

For IEC TR 60825-3 (Guidance for laser displays and shows) Ed.3 and IEC TR 60825-14 (Safety of laser products–A user's guide) Ed.2, comments from CD circulation were deliberated and measure policies were agreed.

IEC TR 60825-5 (Manufacturer's checklist for IEC 60825-1) Ed.3

was issued in November.

For IEC TR 60825-14 Ed.2, CD comments were deliberated and measure policies were agreed.

3.7 Non coherent sources (WG 9)

Regarding IEC TR 62471-2 ED1 (Guidance on manufacturing requirements relating to non-laser optical radiation safety), revision as a requirement was proposed by the convenor and opinions were exchanged.

For IEC TR 62471-4 ED1 (Measurement method), it was decided to proceed to DTR circulation.

For IEC 62471-6 ED1 (UV lamp system), comments from NP circulation were deliberated. It was decided to exclude lamps for suntan purposes and proceed to CD circulation.

3.8 IEC 62471-1 Special joint TC (JTC 5)

Revision work on CIE S009/IEC 62471 (Photobiological safety of lamps and lamp systems) has been conducted by CIE's Div.2 and Div.6 and IEC's Joint TC (JTC5) of TC 34 and TC 76 since April 2013.

Regarding the procedure for revision to CIE S009/IEC 62471-1, it was confirmed to conduct deliberation and voting at the JTC as revised CIE S009 first according to the CIE procedure, and then propose the revised CIE S009 to IEC as the FDIS of IEC 62471-1.

3.9 IEC/TC76/ IEC/ISO - Safety of lasers and laser equipment in an industrial materials processing environment linked to ISO/TC 172/SC 9 (JWG 10)

Regarding ISO/IEC 11553-1 (Laser processing machines – Laser safety requirements) Ed.2, an FDIS was circulated after the meeting, and it was decided to proceed to issuance in FY2020.

For ISO/IEC 11553-2 (Safety requirements for handheld laser processing devices) Ed.2, it was decided that China would act as PL to resume the revision project in FY2020.

3.10 Eye and face protection against laser radiation linked to ISO/TC94/SC6 (JWG 12)

For ISO 19818-1 (Requirements and test methods) Ed.1, a WD was deliberated and it was agreed to proceed to issuance by skipping CD stage.

For ISO/TR 19818-2 (Guidelines on selection and use) Ed.1, the draft was deliberated and it was agreed to add it as a preparatory work item.

4. ISO/TC 172/SC 9 Standardization Meeting (ISO/TC 172/SC 9 Laser and Electro-Optical Systems)

The ISO/TC 172/SC 9 Standardization Meeting conducts various activities including collecting domestic opinions and reviewing draft international standards proposed by ISO/TC 172/SC 9, which is engaged in preparing international standards on laser products (composed of WG 1: Terminology and test methods for electro-optical systems, WG 4: Laser systems for medical applications, WG 7: Electro-optical systems other than lasers, and JWG 3: Joint work group of ISO/TC 172/SC 9 and IEC/TC 76 on laser equipment safety).

This fiscal year, a deliberation meeting was held before the China international conference in November 2019. It had been planned to report at the international conference in March 2020 and deliberate strategies for the next international conference, but the meeting was canceled due to the global spread of coronavirus infections. Then, document deliberation was conducted by e-mail.

In FY2019, the international conference was held in China Jiliang University, Hangzhou. Described below is the progress of deliberations by each WG.

4.1 Terminology and test methods for electro-optical systems (WG 1)

The deliberations were conducted as follows for each item:

- ISO 11146 (Lasers and laser-related equipment -- Test methods for laser beam widths, divergence angles and beam propagation ratios) -1 (Part 1: Stigmatic and simple astigmatic beams), -2 (Part 2: General astigmatic beams): It was decided to skip CD stage and proceed to DIS.
- ISO 13696 (Optics and optical instruments -- Test methods for radiation scattered by optical components): CD voting is scheduled around May 2020. The standard development period was extended to 48 months.
- ISO 13142 (Electro-optical systems -- Cavity ring-down technique for high-reflectance measurement): It was decided to complete the final document by around March 2021. In addition, the name was revised.
- ISO 12005 (Lasers and laser-related equipment -- Test methods for laser beam parameters – Polarization): It was decided that Japan would act as PL and the project would be started through standard development registration.
- ISO 23701 (Optics and photonics -- Laser and laser-related equipment -- Photothermal technique for absorption measurement and mapping of optical laser components): USA voted against it but it was approved to proceed to NP stage. It was decided to submit a WD in July 2020.
- ISO 22247 (Optics and Photonics -- Effective numerical aperture of laser lenses -- Definition and verification procedure): Development project was approved as TS (Technical Specification).

4.2 Laser systems for medical applications (WG 4)

- ISO 22248 (Lasers and laser-related equipment -- Test methods for laser-induced damage threshold -- Classification of medical beam delivery systems): It was decided to circulate a DIS in around January 2020.

4.3 Electro-optical systems other than lasers (WG 7)

- ISO 15902 (Optics and photonics -- Diffractive optics – Vocabulary): Editorial errors and others were reported from Japan serving as PL. (Issued in December 2019)
- ISO 11807 (Integrated optics – Vocabulary) -1 (Part 1: Basic terms and symbols), -2 (Part 2: Terms used in classification): It was decided to submit a DIS document to the secretary in December.
- ISO 14880 (Optics and photonics -- Microlens arrays-1 (Part 1: Vocabulary): Comments from USA were deliberated and approved.

5. Optical Disc Standardization Meeting

The Optical Disc Standardization Meeting is a standardization group specializing in the standardization of optical disc related technologies. Its main tasks are to prepare drafts of domestic standards and to survey and research the trends in the related technologies.

The Optical Disc Standardization Meeting has functional submeetings to carry out the activities. The core meeting determines activity policies by each submeeting, supervises their activities, and deliberates and approves JIS drafts. The submeetings undertake specific work to promote the overall activities.

In FY2019, the Application Submeeting was integrated into the Media Submeeting to transition to a two-submeeting system.

For survey and research, the Media Submeeting conducted a future technology trend survey. In addition, an international standardization trend survey was also conducted, independent of the submeeting framework, to provide the latest information to optical disc users.

5.1 Media Submeeting

From FY2019, the Media Submeeting efficiently conducts the survey and research activities regarding the standardization of physical formats, applications, and reliability evaluation for all optical discs (magneto-optical discs, phase change optical discs, recordable optical discs, and read-only media [ROM] optical discs).

In the activity area covered by the former Media Submeeting, the submeeting is watching the progress of revision work by ISO/IEC/JTC 1/SC 23 regarding the international standard that corresponds to the new recordable disc format specifications, which had been updated by the Blu-ray Disc Association (BDA) for 4k/8k broadcast recording.

In the activity area covered by the former Application Submeeting, the submeeting is watching the progress of further revision work by ISO/IEC/JTC 1/SC 23, which is under deliberation in consideration of further users' convenience, regarding the specifications in ISO 29121 (Data migration method for optical discs for long-term data storage), which had been revised in 2018.

5.2 Format Submeeting

The Format Submeeting conducted the following activities, including continuing items from FY2018, in the survey and research on volume and file formats of optical discs.

(1) Development of large capacity file system

Following FY2018, a proposal document including user requests for archive file systems and issues with implementation was submitted to the Ecma TC31 conference and discussion was made. The submeeting also supported joint work being undertaken by Ecma TC31 for IEC/TC 100.

(2) Development of ISO 9660 Amd.2

Regarding ISO 9660, which defines the logical format of a CD-ROM, ISO 9660/Amd.2 was developed as a revision to include the extended specification Joliet after the disclosure of the specification contents was permitted by Microsoft. The final publication proceeding is underway as of March 2020.

After ISO 9660 Amd.2 is issued, development of ISO 9660 Ed.2 will be started to reflect the amendment up to Amd.2. Relevant responses to Ecma are planned to be started after the content of Ed.2 is confirmed.

In addition, after Ed.2 is confirmed, the revision proceeding for JIS X 0606 will be started to conduct the revision work in tandem with the Ed.2 development.

6. International standardization on Evaluation of EMC and related Characteristics of High-Speed In-Vehicle Ethernet Physical Layer (V project 3)

While the capacity of in-vehicle communication is expected to increase drastically due to the development of the advanced driving support systems and autonomous driving, the in-vehicle Ethernet standards, which strengthen real-time performance and fail-safe function, require in-vehicle communication systems to ensure high reliability as a communication backbone and sensor network that connect between base units for self-driving vehicles. Regarding EMC characteristics, a reliable in-vehicle communication system can be achieved by combining a communication board having excellent EMC characteristics with an optical harness that neither generates electromagnetic noise nor has EMC vulnerability.

This project was adopted and initiated in May 2017 and then completed in FY2019 (third year). In the project, regarding the in-vehicle Ethernet serving as the basic in-vehicle communication protocol in the times of autonomous driving, nine communication standards that satisfy high reliability and cost reduction were prepared by effectively incorporating Japanese technologies.

In FY2020, a successor project (V project 4) is planned to be launched to continue the standardization activities.

7. International standardization on Reliability of Narrow-Pitch Multi-Fiber Optic Connectors (NP project)

7.1 Objective

With the acceleration of the globalization of the optical communication system and component industry, including deploying manufacturing bases in Asia, Japan's urgent task is to strengthen the competitive advantages in fields and technologies at which we excel to enhance our international presence. Japan has traditionally offered the high-level product quality and thus should take the world-leading position in constructing highly reliable systems and components.

Optical connectors originated from Japan, such as SC connectors, MU connectors, MT connectors, and MPO connectors have thus far been internationally standardized and used in the global market, accounting for a high share (SC connectors account for about 70% of the global market). The objective of this project is to work on international standardization regarding high-density connection using highly reliable optical connectors we have manufactured with our specialty, thereby establishing standards advantageous to our country's industry ahead of the USA and Europe, and promoting the narrow-pitch multi-fiber optic connector industry.

Narrow-pitch multi-fiber optic connectors can be applied to high-density optical interconnection between the substrates of substrate-embedded optical modules, and their target market is the high-density optical interconnection systems in servers and routers at data centers and other facilities in Japan and overseas. The market began to emerge around 2018, and owing to this project, the volume of the high-density optical interconnection is estimated to increase to about several million units.

Especially in recent years, the volume of information to be processed and communicated at data centers has increased due to the expansion of cloud computing, which has led to the key issue of energy consumption reduction. In order to solve this problem, the application of high-density optical interconnection to servers and routers at data centers and other facilities is being promoted worldwide. To achieve this high-density optical interconnection, this project will work on international standardization of the narrow-pitch multi-fiber optical connector that uses optical fibers with smaller thicknesses compared to the conventional fibers.

One international standard NP for narrow-pitch multi-fiber optical connectors was proposed to IEC/TC 86. The target was set to register the NP and circulate a CD by FY2019.

In FY2019, the third year of this three-year project, domestic opinions on international standardization of narrow-pitch multi-fiber optical connectors were collected based on the results of technical surveys and technical studies such as prototype testing. Then, opinions on the NP draft submitted to IEC were coordinated at the IEC conference. As a result, a CD was circulated and the target was achieved. Furthermore, CC comments for the CD were solved and a CDV was circulated.

7.2 Progress

1) The meeting set up the international standardization proposal committee regarding reliability and others of narrow-pitch multi-fiber optical connectors and participated in JWG9 of the IEC Delft conference in April 2019 to deliberate comments on the circulated NP, which had been proposed as the IEC 62496-4-214 standard (Optical circuit boards - Part 4-214: Interface standards - Terminated waveguide OCB assembly using a single-row thirty-two-channel symmetric PMT connector). It was agreed to prepare a CD. For CD circulation, it was decided to use "214" for the grandchild number.
2) At JWG9 of the IEC Shanghai conference in October, CC comments

on the CD were solved and it was agreed to prepare a CDV. The CDV was circulated on January 3, 2020.

3) For the measurement system evaluation of narrow-pitch multi-fiber optical connectors, a connection loss measurement system evaluation was conducted on a polymer optical waveguide equipped with a narrow-pitch multi-fiber optical connector. A fan-out part was prepared by attaching 12 GI-50 fibers with an outer diameter of 80 μm to a thin-diameter MT ferrule. Then, a polymer waveguide equipped with a both-side PMT connector (core □40 μm) was connected to the fan-out part to measure the EAF (encircled angular flux) of the emission light. As a result, it was confirmed that the EAF could be evaluated at each port of the polymer waveguide whichever an SLD or LED was used as a light source.

4) For the test evaluation of narrow-pitch multi-fiber optical connectors, a connection characteristic evaluation was conducted to check the EAF, connection loss, and crosstalk of a polymer optical waveguide equipped with a narrow-pitch multi-fiber optical connector by using SLD and LED light sources with a wavelength of 850 nm. The EAF obtained when two polymer waveguides were connected did not vary much between cases where the SLD or the LED was used for excitation. The connection loss was roughly 0.4 dB and tended to increase slightly at both-side ports. The connection loss also showed no significant variations depending on the excitation conditions. The crosstalk was roughly -40 dB or less and tended to increase at both-side ports.

   By utilizing the test results in 3) and 4), we will aim to realize the international standardization smoothly.

5) Technical survey was conducted at the international academic meeting, and due to further volume increase at data centers, the followings are required: progressing technologies for the photonic integrated circuit (PIC) such as using silicon, developing on-board optics implementation, and achieving high-density optical interconnection by applying optical transmission between LSI chips. This has highlighted that development and standardization regarding the high-density application of multi-fiber optical connectors will become increasingly important. It is thus thought that the narrow-pitch high-density implementation will be promoted to achieve the high-density application. It was confirmed that collaboration with each relevant standardization organizations such as the COBO (Consortium for On-Board Optics) would be the key to the standardization activities.

Educational and Public Relations Activities

1. FY 2019 Symposium on the Optoelectronics Industry and Technology

The FY 2019 Symposium on the Optoelectronics Industry and Technology was held at the Rihga Royal Hotel Tokyo on Wednesday, February 19th, 2020. The event was jointly sponsored by OITDA and the Photonics Electronics Technology Research Association (PETRA), with support from the Ministry of Economy, Trade and Industry. Under the theme of "Optical Imaging and Sensing Technologies －Seeing the Unseen", six important lectures were given as shown in Table 3. with around 230 participants.

2. InterOpto 2020

InterOpto 2020, an international exhibition of cutting-edge optoelectronics technology, was held at Tokyo Big Sight for three days from January 29th to January 31st, 2020, with support and cooperation from the Ministry of Economy, Trade and Industry and many other organizations.

Covering a wide range of exhibition categories, including laser/light sources, optical devices/modules, materials, optical equipment/instruments, and services/software related to the optoelectronics industry, InterOpto exhibited a broad range of technologies from optoelectronics-related materials to optical application systems.

InterOpto alone featured 97 booths set up by 74 exhibitors from in and outside Japan, including optoelectronics manufacturers and trading companies.

A "Notable Optoelectronics Technology and Special Exhibit Zone" was set up in the Exhibition Hall. In this zone, eight companies recommended by the working groups of OITDA's Optoelectronics Technology Trend Committee exhibited their technologies and products.

On January 29th, the OITDA seminar "Optical Technology for Autonomous Driving" was held. The seminar was followed by a lecture by automobile journalist Kenji Momota on the current state and future outlook of the global market surrounding autonomous driving, followed by four lectures on the latest optical technology for the realization of autonomous driving. It was a seminar on the latest optical technology for autonomous driving, which has great expectations for future development. A total of 330 people participated in the five lectures.

All about Photonics 2020
InterOpto 2020 LED JAPAN 2020 Imaging Japan 2020

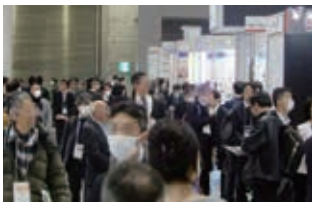


Table 3　FY 2019 Symposium on the Optoelectronics Industry and Technology

10:00 ～ 10:05	Opening Remarks	Mr. Yasuhisa Odani President / Vice Chairman, OITDA
10:05 ～ 10:15	Guest Greeting	Mr. Jingo Kikukawa Director, IT Industry Division, Commerce and Information Policy Bureau, METI
10:15 ～ 11:15	Keynote Speech: Imaging the Shadow of a Black Hole with the Event Horizon Telescope	Dr. Kazuhiro Hada Assitant Professor, Mizusawa VLBI Observatory, National Astronomical Observatory of Japan (NAOJ)
11:15 ～ 12:00	Future Society Created by Sensing Technology	Dr. Makoto Fujimaki Deputy Director, Research Center Team Leader, Sensing System Research Center, National Institute of Advanced Industrial Science and Technology (AIST)
13:00 ～ 13:45	New Development of Endoscopic Imaging Technology	Mr. Makoto Igarashi Technology Innovation, Global Office of Chief Technology Officer, Olympus Corporation
13:45 ～ 14:30	Roadmap of Optical Imaging and Sensing Technology － Seeing the Unseen －	Dr. Yasuyuki Ozeki Associate Professor, Department of Electrical Engineering and Information Systems, The University of Tokyo
14:45 ～ 15:30	Recent HPC Development Activities and "Fugaku" System	Dr. Yuichiro Ajima Senior Architecht, System Development Division, Platform Development Unit, Fujitsu Limited
15:30 ～ 16:15	Integrated Photonics-Electronics Convergence System Technology － Ultra-compact Optical Transceivers for 5G Network －	Mr. Hiroki Yaegashi Photonics Electronics Technology Research Association (PETRA)
16:20 ～ 17:00	The Award Ceremony of 35th Kenjiro Sakurai Memorial Prize	
17:00 ～ 19:00	Get-together	

3. 35h Kenjiro Sakurai Memorial Prize

The Kenjiro Sakurai prize was established as a memorial to the late Dr. Kenjiro Sakurai, a former director of OITDA who played a major role in developing the optoelectronics industry. Its purpose is to promote the technological development of the industry. The prize has been given out 34 times to 24 individuals and 41 groups, for a total of 162 awardees.

This year, the Kenjiro Sakurai Memorial Prize was awarded to one group out of 14 applications for their pioneering achievements in the optoelectronics industry and technology since 2009.

The prize was awarded to Dr.Shinji Matsuo, Dr.Takaaki Kakitsuka, Dr.Tomonari Sato and Dr.Koji Takeda of Nippon Telegraph and Telephone Corporation. "Development of low-threshold and high-speed semiconductor membrane lasers"

The award ceremony was held on February 19th, 2020 following the FY 2019 Symposium on the Optoelectronics Industry and Technology. At the ceremony, Dr.Yasuhiko Arakawa (The University of Tokyo), who is the chairperson of the Kenjiro Sakurai Memorial Prize Committee, reported on the selection process and results. This was followed by the presentation of certificates, medals, and extra prizes to the awardees.

Awardees of the 35th Kenjiro Sakurai Memorial Prize
From left: Dr.Koji Takeda, Dr.Takaaki Kakitsuka, Dr.Shinji Matsuo, Dr.Tomonari Sato

Supporting Members

(As of March 31, 2020)

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Mitsubishi Chemical Holdings Corporation

Nissan Chemical Corporation

Shin-Etsu Chemical Co., Ltd.

Sumitomo Bakelite Co., Ltd.

Yamamoto Kogaku Co., Ltd.

[Glass & Ceramics]

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Corning International K.K.

Nippon Sheet Glass Co., Ltd.

Sumitomo Osaka Cement Co., Ltd.

Toyo Seikan Group Holdings, Ltd.

[Electric Wire & Cable]

Fujikura Ltd.

Fujikura Dia Cable Ltd.

Furukawa Electric Co., Ltd.

Sumitomo Electric Industries, Ltd.

SWCC Showa Holdings Co., Ltd.

[Electronics & Electronic Appliances]

Asahi Kasei Microdevices Corporation

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[Electric Power]

Central Research Institute of Electric Power Industry

[Other Manufacturing]

Adamant Namiki Precision Jewel Co., Ltd.

Dai Nippon Printing Co., Ltd.

Optoquest Co., Ltd.

[Others]

Granopt Ltd.

Institute for Laser Technology

Japan Optomechatronics Association

KDDI Research, Inc.

Nippon Telegraph and Telephone Corporation

NTT Advanced Technology Corporation

Photonics Electronics Technology Research Association (PETRA)

TOYOTA Central Research and Development Labs., Inc.

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